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INFRARED EMISSION AND MICROWAVE BACKGROUND ANISOTROPY FROM COSMOLOGICAL N-BODY SIMULATIONS

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SUMMARY

This grant supported the work at MIT of Professor Edmund Bertschinger and graduate research associate Uros Seljak in the areas of cosmic microwave background anisotropy and cosmic structure formation. It also supported the collaborative research of Bertschinger with Chuck Bennett of NASA-GSFC and James Mahoney of Marlboro College.

Seljak and Bertschinger performed research on several theoretical aspects of cosmic microwave background anisotropy. In their first paper (Seljak & Bertschinger 1993a), they presented a maximum-likelihood analysis of the COBE angular correlation function. Although our results have been superceded by later data, we made a useful contribution in presenting a new analysis method that has since been adopted by other workers.

In two papers, Seljak & Bertschinger (1993b, 1994b) used the POTENT reconstruction of the mass density field in the nearby universe to estimate the amplitude of the density fluctuation spectrum for various cosmological models, and compared the results with the COBE normalization. They found that a cold dark matter-like spectrum was favored provided Ω is not much less than one.

Work by Ma & Bertschinger (1994), Seljak & Bertschinger (1994a), and Seljak (1994a) considered the generation and linear evolution of microwave background anisotropies. Ma & Bertschinger presented the detailed formalism and results for models of mixed hot and cold dark matter. Seljak in the two papers presented a two-fluid approximation that gives 10–20% accuracy and good physical insight at small computational expense.

In his most recent paper, Seljak (1994b) presented a calculation of the effects on gravitational lens image positions and time delays due to intervening large-scale structure. For some time there have been questions about the effects of superclusters and voids on gravitational lens systems. Seljak neatly polished up this problem with a new formulation of lensing theory in a perturbed Robertson-Walker spacetime. The bottom line is that time delays and image separations for typical arcsecond lens systems are affected by only a few percent.

Bertschinger published several reviews and pedagogical papers on large-scale structure. The first (Bertschinger 1993a), for Texas/PASCOS 92, reviewed the standard scenarios for the formation of galaxies and large-scale structure. A longer and more complete review was presented in the refereed proceedings of CNLS 13 (Bertschinger 1994). A short contribution on gravitational clustering theory and statistics was made to the 1993 Les Houches Winter School on Transport in Plasma, Astro-, anbd Nuclear Physics (Bertschinger 1993b). A much longer pedagogical set of lecture notes was made for the 1993 Les Houches Summer School on Cosmology and Large Scale Structure (Bertschinger 1995), where Bertschinger was one of the key lecturers. These lecture notes present the Newtonian and relativistic theories of the evolution of small-amplitude perturbations in an expanding universe and include some new research results in addition to a coherent pedagogical formulation of the subject.

Besides this published and submitted work, Bertschinger has an ongoing collaboration with Bennett and Mahoney to study structure formation in a model with a cosmological constant and cold dark matter. We have a manuscript in preparation but its conclusion has been delayed by the precedence of the other activities listed above.

Reprints of several of the refereed articles published under this grant are attached.

Publications supported by NASA NAGW-2807

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